LASER THRUSTER

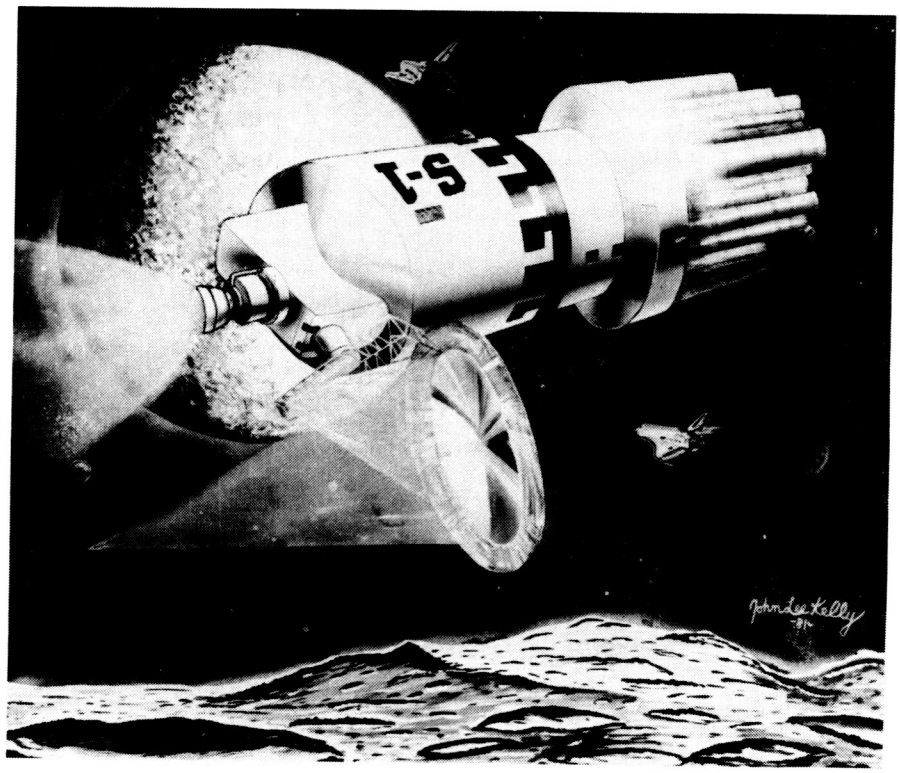
N. W. Jalufka

Physics Department

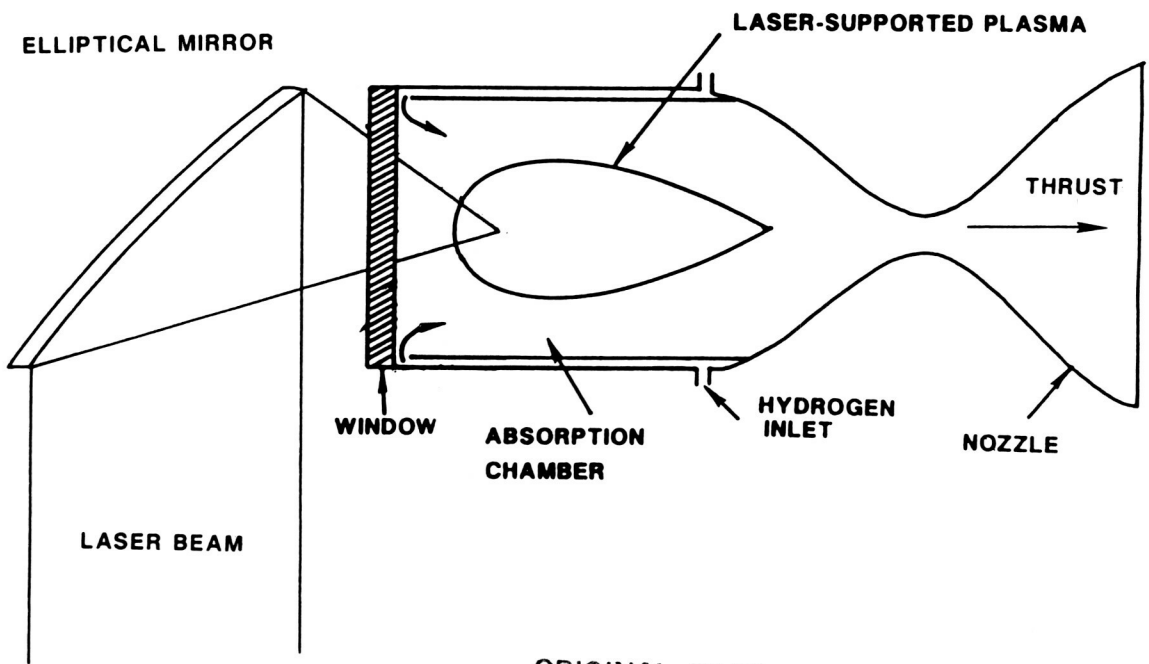
Hampton University

Hampton, Virginia

Artist's Concept of Laser Thruster



LASER ROCKET THRUSTER



DESIGN OF LASER THRUSTER

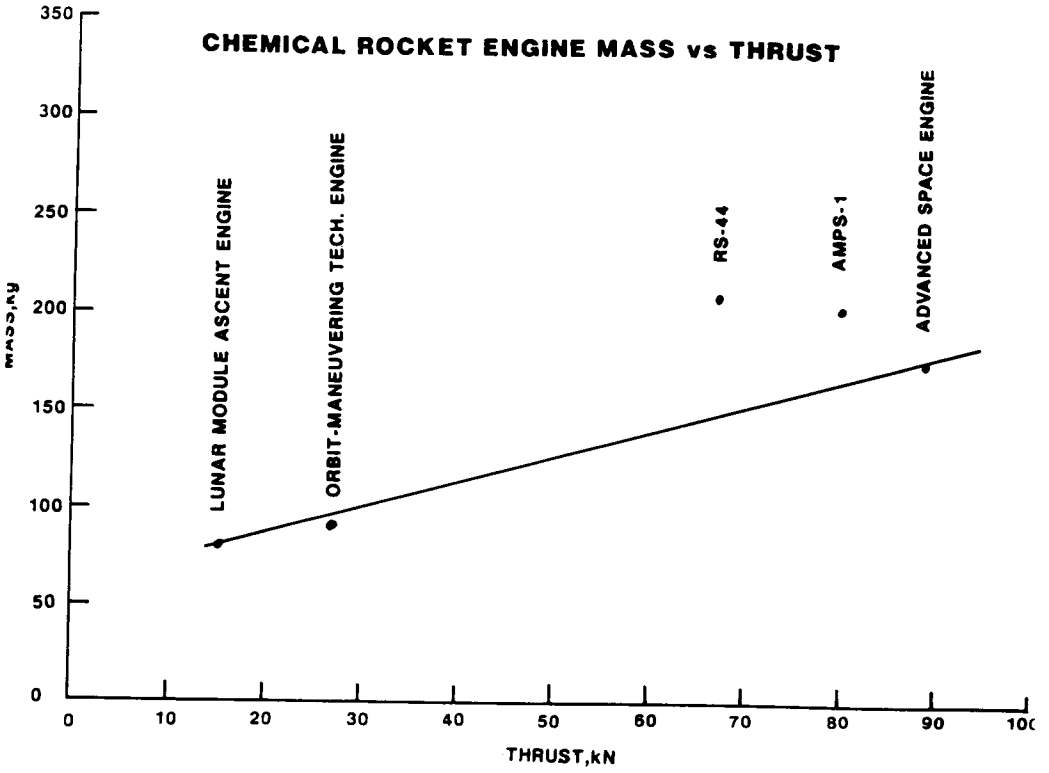
- Laser Power - 50 to 500 Mwatts
- Specific impulse - 1500 sec.
- Thrust ~ 35000 N - Maximum
- Fuel - H_2
- 60% efficiency (for calculations)
- Maximum Transmission Distance - 50,000 kM

BASIS FOR WEIGHT DETERMINATION

- Thruster not any heavier than a chemical rocket engine.
- Addition of absorption chamber should not increase weight more than a factor of 2.
- Weight of thruster plus optics chosen for system - 279 kg.

*Agrees with value given in:

Glumb, Ronald J., "Laser Propulsion for Earth-Moon Transporation Systems," presented at the Symposium on Lunar Bases and Space Activities in the 21st Century, Houston, TX, 1988, Paper No. LBS-88-086.



COLLECTOR-FOCUSSING MIRROR WEIGHT*

- Adaptive Optics - 30 kg/m^2
- Non-adaptive Optics - 2 kg/m^2
- For 3 meter by 4.25 meter elliptical mirror
  - + Adaptive Optics - 300 kg.
  - + Non-adaptive Optics - 20 kg.

*Values taken from:

Frisbee, R. H., Horvath, J. C. and Sercel, J. C., "Space-Based Laser Propulsion for Optical Transfer," JPL Report D-1919, December 1984.

OTV VEHICLE MASS*

Structure	2303 kg.
Tanks	1614 kg.
Propulsion Systems-Chemical	1419 kg.
Thermal Control Systems	242 kg.
GN & C	68 kg.
Electrical Systems	252 kg.
Aerobrake	1042 kg.
Residuals	1571 kg.
	8511 kg.
Laser Thruster & Collecting Optics	279 kg.
	8790 kg.

*Hoy, D., Johnson, III, L. B., Persons, M. B., & Wright, R. L.: Conceptual Analysis of a Lunar Base Transporation System, Symposium on Lunar Bases & Space Activity in the 21st Century, Houston, TX, 1988, Paper LBS-88-233.

The Laser Propulsion Vehicle Used in This Study Has The Following Characteristics:

- Thruster Efficiency - 60%
- Thruster Weight - 259 kg.
- Collection Mirror Weight - 20 kg.
- Total Vehicle Dry Weight - 8790 k

Laser Propulsion Payoff Summary

- Laser propulsion can reduce fuel by 57 t to 105 t over chemical propulsion for 144 t Lunar base, with no significant increase in trip time.
- Laser Propulsion reduces trip time by a factor of 40 to 120 over nuclear electric propulsion and time in radiation belts by a factor of 100 to 1700.
- Either solar or nuclear driven laser diode arrays could produce multimegawatt beams, typically 3,700 t for a 235 MW laser system.
- Laser diode arrays have high payoff due to short wavelength (850nm) and high diode efficiency (70%).
- A dry laser OTV of 8790 kg and 60% efficiency can transport 144 t lunar base.
- Laser Propulsion could carry both personnel and cargo safely to the lunar base.
- Large power beaming infrastructure required thus powering multiple missions essential.